OPUHA WATER LTD
Enabling | Sustainable | Growth

Quarterly Water Quality Report

June 2022 to August 2022

Key Findings

- Increased inflows into Lake Opuha during July and August resulted in a significant increase in lake **turbidity** (>100 NTU at surface, >200 NTU at depth) and elevated levels of **nitrogen** and **phosphorus**.
- Rainfall across the wider catchment in July and August caused nitrate levels to increase in the major rivers (North Opuha, South Opuha, Opuha, Opihi and Te Ana Wai) and many tributaries.
- Elevated ***E.coli*** levels detected in Ribbonwood Creek, Station Creek and Lake Opuha at Ewart's Boat Ramp in July after a 15-25 mm rain event. Work is being undertaken to determine the ***E.coli*** source.
- The **cyanobacteria** alert for Lake Opuha was removed at the end of August. The alert was originally issued in May and was in place for 94 days.
- **Heavy metals** and **DDT** sampling in the Opuha River over the June – August quarter showed low levels with no public health or ecological concerns.
- Sampling in the Kakahu River was undertaken in June and the data obtained was typical with no extreme results.

Introduction to Opuha Water's Quarterly Water Quality Report

Water quality is monitored on a quarterly to monthly basis at Lake Opuha and several waterways across the Opuha Scheme and wider Opihi catchment. Opuha Water Ltd (OWL) have several water quality monitoring programs that focus on different areas of interest, such as Lake Opuha and its tributaries, the Upper Opihi River and its tributaries, the Opuha River and lower Opihi River, the Te Ana Wai River and the Kakahu River. During the irrigation season, water quality monitoring also occurs within OWL's irrigation schemes.

Water samples are collected and analysed for nitrogen, phosphorus, chlorophyll-a, iron, manganese, heavy metals, pesticides, *E. coli*, cyanobacteria, water clarity, dissolved oxygen, pH and conductivity. River surveys for benthic periphyton (material attached to the surface of rocks in the water) are also undertaken to better understand river health and quantify the coverage of cyanobacteria and nuisance algae. The specific parameters analysed at each site depends on the objectives of the individual sampling programs.

OWL reviews the data on a monthly basis to identify any significant changes in water quality across the scheme and produce a quarterly report for shareholders and stakeholders.

The objective of this report is to highlight interesting data collected over the quarter for each of OWLs water quality monitoring programs and to track short-term changes. A more in-depth investigation of the water quality data such as trend analysis, statistical analysis and comparison to guidelines will be undertaken in OWL's Annual Water Quality Report which is published in the first quarter of each year.

Additional information regarding sampling sites is given in *Appendix A – Sampling Locations.*

Lake Opuha

Continuous water quality monitoring occurs at Lake Opuha via sensors located on the lake tower – sensors measure dissolved oxygen, conductivity, turbidity and temperature close to the lake surface (5 m below the surface) and at depth (close to the bottom of the lake). In addition to continuous water quality monitoring, water quality samples are also collected at the lake and sent to a laboratory for analysis. This type of sampling is undertaken for monitoring cyanobacteria (sampled monthly) and chlorophyll-a, total nitrogen and total phosphorus (all sampled quarterly).

The water quality parameters of interest for the 2022 June-August quarter are **turbidity**, **total nitrogen (TN)**, **total phosphorus (TP)** and **cyanobacteria**.

Turbidity within the lake is typically below 10 NTU and is often less than 5 NTU. In mid-July and early-August there were increased inflows into the lake which caused a significant increase in turbidity (Figure 1). Lake turbidity was <5TU in early July and increased to over 100 NTU at the lake surface (—) and over 200 NTU at depth (—) as inflows increased during July and August.

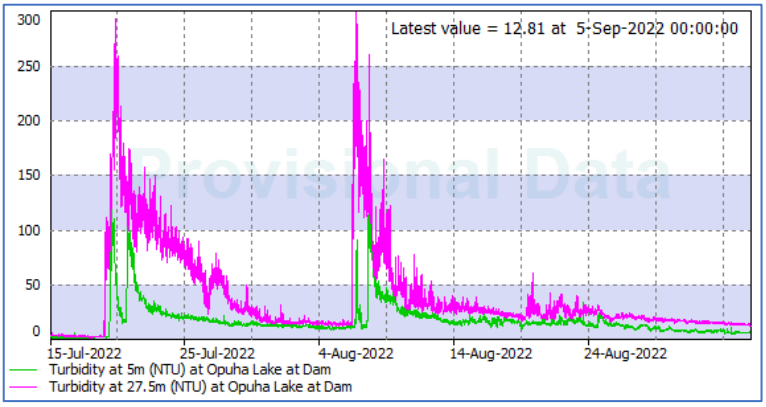


Figure 1: Turbidity in Lake Opuha at surface (—) and depth (—).

Figure 2 shows the **TN** and **TP** concentrations at Lake Opuha since 2016 and shows sample data (●), annual medians (—) and the National Policy Statement (NPS) band levels (---). The increase in TN and TP observed in August 2022 was the first time the lake was sampled since the increased inflows in mid-July 2022. The increase in TN and TP was smaller than the increase recorded in August 2021, which was the first time that the lake was sampled after the May 2021 rain event.

Figure 2 also compares the annual median values (—) to the NPS band levels (---) to determine which band the lake sits in. Since 2016, Lake Opuha has achieved either Band B or Band C status for TN and either Band A or Band B status for TP.

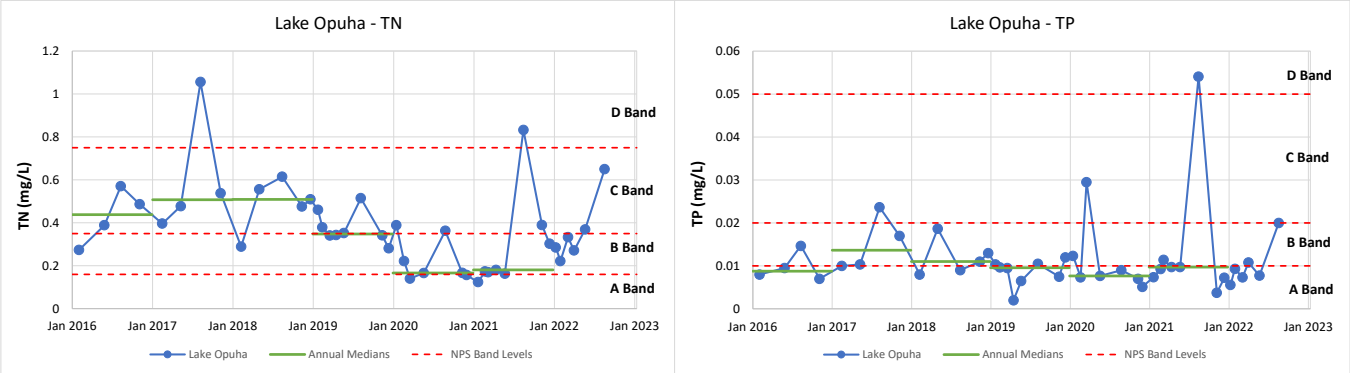


Figure 2: TN and TP levels at Lake Opuha since 2016. sample data (●); annual medians (—); NPS band levels (---).

In May 2022, a **cyanobacteria** alert was issued for Lake Opuha due to the presence of scums which were identified as *Woronichinia naegeliana* (Figure 3). The scums were observed at Ewarts Boat Ramp, Bennetts Recreational Reserve Boat Ramp, Dam Boat Ramp and along the dam wall. The cyanobacteria persisted until mid-July when increased inflows and turbidity in the lake caused the cyanobacteria to dissipate. The cyanobacteria alert for Lake Opuha was removed on 29 August 2022 – 94 days after it was issued.

The next report will focus on the Trophic Level Index (TLI) which is a metric used to give an overall picture of the health of a lake.

Figure 3: Cyanobacteria scums at A) Dam boat ramp area and B) Bennetts recreation reserve boat ramp, on 16 May 2022.

Tributaries of Lake Opuha

Water Quality monitoring is undertaken in the North Opuha River, South Opuha River, Ribbonwood Creek, Station Creek and Deep Creek. Monitoring in the North Opuha River and South Opuha River commenced in 2019, whereas monitoring in Ribbonwood Creek, Station Creek and Deep Creek started in February 2022. The water quality parameters of interest for the 2022 June-August quarter are **nitrate** and ***E.coli***.

Increased **nitrate** levels were observed in the North Opuha River and South Opuha River during the winter period (Figure 4) and peaked in July. Nitrate levels in July were the highest observed since sampling commenced in 2019. In the eight days prior to sampling in July, over 88 mm of rain was recorded at Environment Canterbury's (ECan) Kimbell rain gauge and over 105 mm at ECan's Clayton rain gauge. Flows in the North Opuha River and South Opuha River peaked at 40 m^3/s and 60 m^3/s, respectively, and had receded to 3 m^3/s and 4 m^3/s, at the time of sampling in July. The South Opuha River – Above Abstractions site was not sampled in July or August due to access after the rain event. Nitrate levels had decreased slightly when sampled in August.

Figure 4 shows higher levels of nitrate in the North Opuha River at Clayton Settlement Road (downstream) compared to Above Abstractions (upstream); Clayton Stream (typical nitrate levels of 1 mg/L) enters the North Opuha River between these two locations. Work is currently being undertaken by OWL to quantify the nitrate contribution and source from Clayton Stream – results from this investigation will be reported in future quarterly reports.

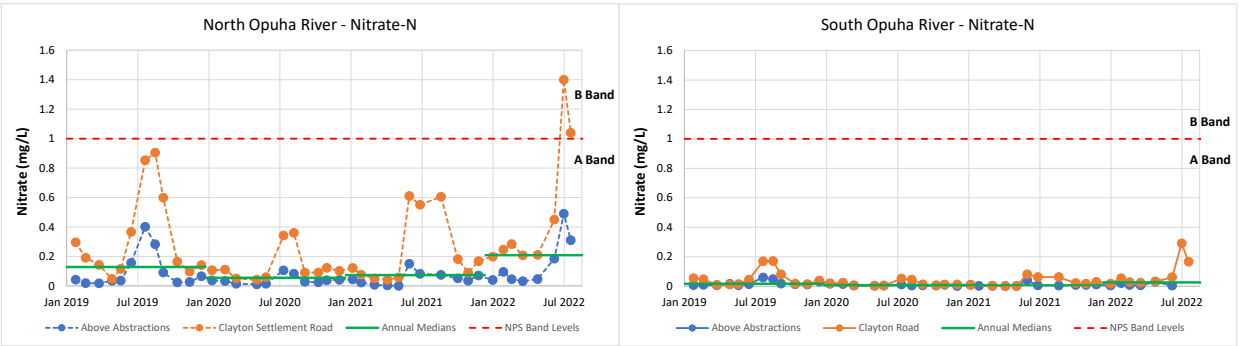


Figure 4: Nitrate levels in the North Opuha River and South Opuha River since 2019. Sample data (● and ●); annual medians (—); NPS band levels (---).

Figure 4 also shows the overall annual median values for the North Opuha River and the South Opuha River (—) and the NPS band levels for nitrate toxicity (---). Since sampling began, both rivers have comfortably achieved Band A status for nitrate toxicity.

Nitrate levels in Ribbonwood Creek (Clayton Road) and Station Creek (Clayton Road) increased during July due to increased inflows from the rain event (Figure 5) – nitrate levels slightly decreased in August. Nitrate concentrations in Ribbonwood Creek, Station Creek and Deep Creek are generally higher than the nitrate levels in the North Opuha River and the South Opuha River, however the flows in Ribbonwood, Station and Deep creeks are lower and therefore the mass of nitrate they contribute to the lake is considerably less. Figure 5 also shows the median values (calculated from Feb 2022 to Aug 2022) for Ribbonwood Creek, Station Creek and Deep Creek (—) and the NPS band levels for nitrate toxicity (---). All three rivers have so far achieved Band A status for nitrate toxicity, however the median value of 0.95 mg/L for Ribbonwood Creek is close to the NPS B Band level of 1 mg/L.

OWL is currently undertaking work to examine nitrate concentrations along Ribbonwood Creek, Station Creek and Deep Creek to determine nitrate sources within the catchment.

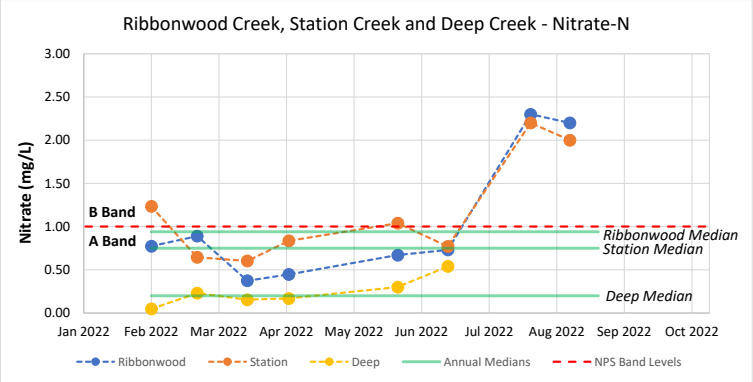


Figure 5: Nitrate levels in Ribbonwood Creek (Clayton Rd), Station Creek (Clayton Rd) and Deep Creek (before entering Lake Opuha). Sample data (●); annual medians (—); NPS band levels (---).

Over the last 5 years, elevated levels of ***E.coli*** have been reported for Ewarts Boat Ramp at Lake Opuha, which has resulted in an *"Unsuitable for Swimming"* advisory for this location. Ribbonwood Creek and Station Creek are nearby and are believed to be the source of *E.coli* affecting Ewarts Boat Ramp. *E.coli* sampling was undertaken on 8 July 2022 when between 15-25 mm of rain had been recorded immediately prior to sampling. At the time of sampling, river flows had increased and high levels of *E.coli* were recorded at Ribbonwood Creek – Clayton Rd (2,600 cfu/100 mL), Station Creek – Clayton Rd (2,500 cfu/100 mL) and Ewarts Boat Ramp (1,100 cfu/100 mL) – these levels of *E.coli* at Ewarts Boat Ramp would be considered *"Unsuitable for Swimming"*. OWL are currently undertaking studies to determine the source of *E.coli* in Ribbonwood Creek and Station Creek and to also determine how long high *E.coli* levels persist for at Ewarts Boat Ramp. This work will allow OWL to better communicate the risk associated with *E.coli* to water users, after rain events.

Upper Opihi River and Tributaries

Monthly water quality monitoring is undertaken in the Upper Opihi River and its tributaries. This sampling program started in January 2022 to understand the nitrate levels in the tributaries and their contribution to the Upper Opihi River. **Nitrate** is the water quality parameter of interest for the June-August quarter.

The major tributaries of the Upper Opihi River that are monitored include: Wellshot Stream, Hall Stream, Glenfield Stream, Allandale Stream, Strathconan Stream and Coal Stream. Figure 6 shows the **nitrate** levels in the monitored tributaries with Glenfield Stream generally having the highest nitrate concentrations and Wellshot and Hall Stream having the lowest nitrate concentration. The data shows that Wellshot Stream and Hall Stream achieve Band A status in the NPS, Coal Stream, Strathconan Stream and Allandale Stream achieve Band B, whereas Glenfield Stream achieves Band C.

Figure 7 shows the nitrate levels in the Upper Opihi River and indicates the locations where the tributaries enter the Upper Opihi River. The nitrate concentrations in the Upper Opihi generally increase from upstream to downstream, with the largest nitrate increase occurring downstream of where Glenfield Stream and Allandale Stream enter the Upper Opihi. Work will continue to examine the impacts of the tributaries on the Upper Opihi River and the source of nitrate within these tributaries.

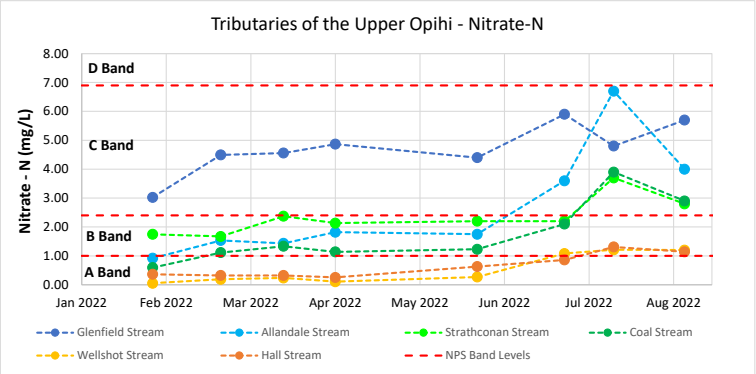


Figure 6: Nitrate levels in the tributaries of the Upper Opihi River – Glenfield Stream, Allandale Stream, Strathconan Stream, Coal Stream, Wellshot Stream and Hall Stream. Sample data (●); annual medians (—); NPS band levels (---).

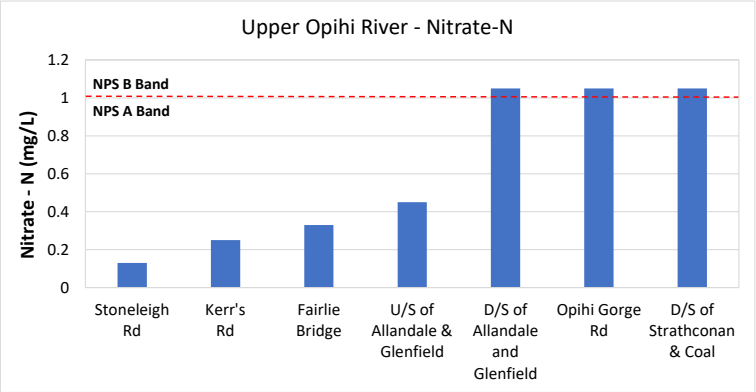


Figure 7: Nitrate levels in the Upper Opihi River. Sampling locations are from upstream to downstream.

Opuha River and Lower Opihi River

Monthly water quality monitoring is undertaken in the Opuha River (Downstream Weir, Gorge and Skipton Bridge) and the Lower Opihi River (Raincliff and Pleasant Point). Sampling at the Gorge, Skipton Bridge and Pleasant Point began in 2014, Raincliff in 2015 and the Downstream Weir in 2021. **Nitrate** and **heavy metals/DDT** are the water quality parameters of interest for the June-August quarter.

Figure 8 shows the **nitrate** concentrations in the Opuha and Opihi River from January 2018 – note that the nitrate levels at the Gorge and Skipton Bridge locations are very similar and only the Skipton Bridge levels can be clearly observed in Figure 8. Increased nitrate levels were observed at all sampling locations during July with nitrate levels at Opihi River – Saleyards Bridge (Pleasant Point) increasing from 0.8 mg/L in July to 4.6 mg/L in August.

Based on data since January 2018, all sampling locations would achieve NPS Band A or Band B status.

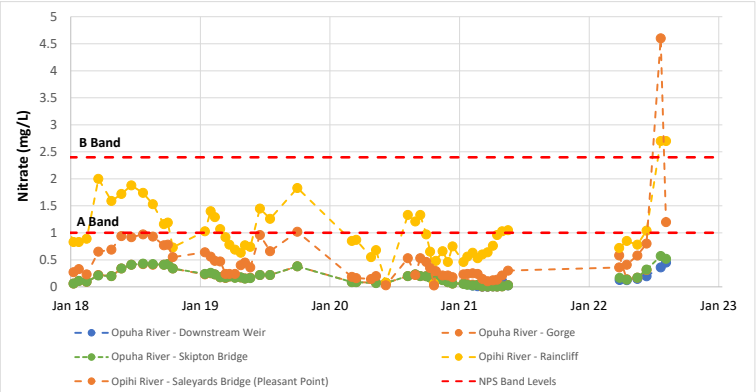


Figure 8: Nitrate levels in the Opuha River and Opihi River since 2018. Sample data (●); NPS band levels (---).

Heavy metals (antimony, arsenic, cadmium, chromium, copper, lead, nickel and zinc) are monitored monthly, and **DDT** (pesticide) is monitored quarterly, at the Downstream Weir location. July sampling showed some elevated heavy metal levels due to increased inflows, but overall the levels of heavy metals and DDT would not cause any public health or ecological concerns.

The next report (which will be distributed in February 2023) will focus on comparing the heavy metal and DDT concentrations to national guidelines and will further explain the significance of the results and how they are calculated/interpreted.

Te Ana Wai River

Water Quality monitoring in the Te Ana Wai River started in 2019 and is undertaken at four locations: Albury, Cave, Chisholm Road and Te Ngawai Road Bridge. The water quality parameters of interest for the June-August quarter are nitrate and *E.coli*.

Increased **nitrate** levels were observed at all four locations during this quarter (Figure 9). Nitrate levels at Cave, Chisholm Road and Te Ngawai Road Bridge in July were the highest observed since sampling commenced in 2019. In the eight days prior to sampling in July, over 105 mm of rain was recorded at ECan's Opihi rain gauge and Mackenzie Pass rain gauge. Flows in the Te Ana Wai River at Cave peaked at 150 m^3/s and had receded to 6.5 m^3/s at the time of sampling. Nitrate levels had decreased slightly when sampled in August.

Figure 9 also compares the annual median values for all sampling sites (—) to the NPS band levels for nitrate toxicity (**---**) to determine which band the Te Ana Wai River sits in. Since sampling began, overall the Te Ana Wai River has comfortably achieved Band A status for nitrate toxicity.

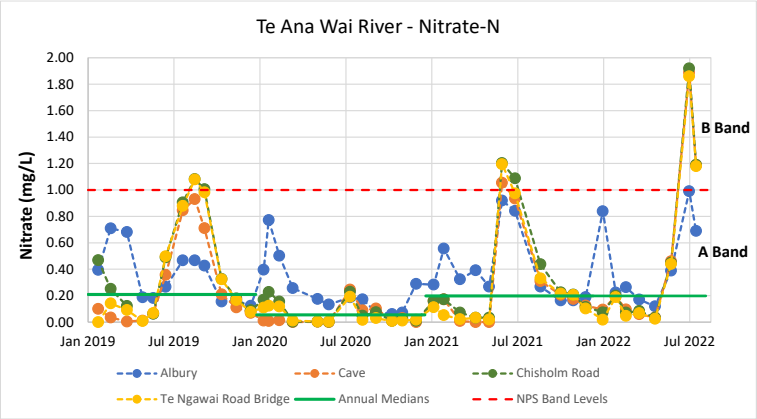


Figure 9: Nitrate levels in the Te Ana Wai River since 2019. Sample data (●); annual medians (—); NPS band levels (---).

E.coli sampling on 8th August 2022 showed elevated levels across all sampling locations (Figure 10). *E.coli* levels increased from the most upstream location (Albury – 90 cfu/100 mL) to the most downstream location (Te Ngawai Road Bridge – 1,100 cfu/100 mL). In the 48 hours prior to sampling, 37 mm of rainfall was recorded at the Mackenzie Pass rain gauge and 29 mm of rainfall was recorded at the Opihi rain gauge. Peak flow was recorded on 6th August 2022 (79 m^3/s) and at the time of sampling the flow was 20 m^3/s.

Analysis of all data since 2019 shows that, overall, the Te Ana Wai River has achieved NPS Band A status for *E.coli,* indicating that the risk of infection from contact recreation is low.

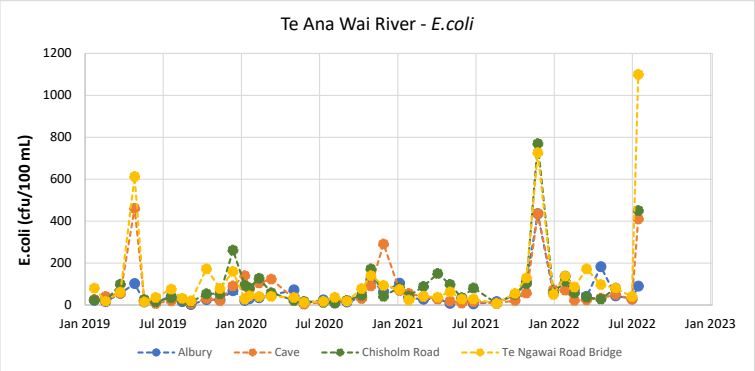


Figure 10: E.coli levels in the Te Ana Wai River since 2019.

Kakahu River

Water Quality monitoring in the Kakahu River is undertaken during the irrigation season and more recently, selective months outside of the irrigation season. Going forward, sampling in the Kakahu River will be undertaken monthly over the entire year. Sampling is undertaken at five locations on the Kakahu River – Mulvihills Flow Recorder, 30 m Upstream of the Pipeline Discharge, 100 m Downstream of the Pipeline Discharge, Morrison's Bridge and Winchester Hanging Rock Road Bridge.

In the June-August quarter, sampling was undertaken in June and the data collected was typical with no extreme results. Therefore, this report will focus on the general effects that the pipeline discharge has on **faecal bacteria** (faecal coliforms) and **water clarity** in the Kakahu River.

Figure 11 shows the faecal bacteria levels in the Kakahu River upstream and downstream since January 2017 (* in Figure 11 indicates when no discharge was occurring). Typically, the faecal bacteria levels upstream of the discharge in the Kakahu River are higher than levels downstream of the discharge – the discharge dilutes the faecal bacteria, lowering and hence improving water quality. On 75% of occasions since January 2017, the downstream site has had lower faecal bacteria than the upstream site. When the discharge causes a dilution in faecal bacteria levels, it reduces the faecal bacteria by 217 cfu/100 mL on average (median = 90 cfu/100 mL).

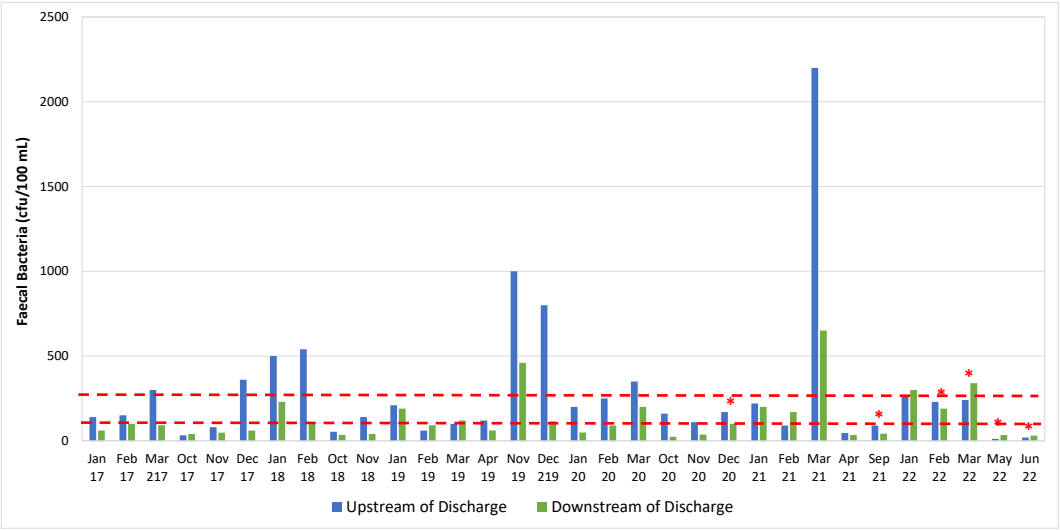


Figure 11: E.coli levels in the Kakahu River upstream and downstream of the pipeline discharge

The discharge into the Kakahu River tends to affect the clarity of water downstream of the discharge. **Water clarity** is measured by placing a black disc in the river and viewing the black disc underneath the water surface by using an underwater viewer/periscope. The black disc water clarity is the distance that the black disc can be observed. The greater the distance the better the water clarity. OWL's consent allows a 50% reduction in clarity between the upstream (30 m) and downstream (100 m) monitoring sites and Figure 12 shows the difference in clarity from October 2014 to June 2022.

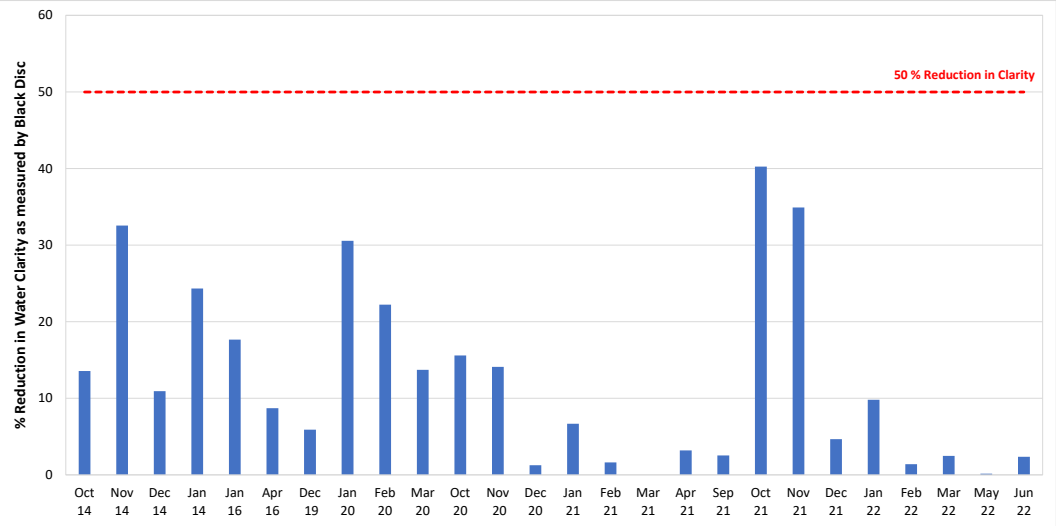


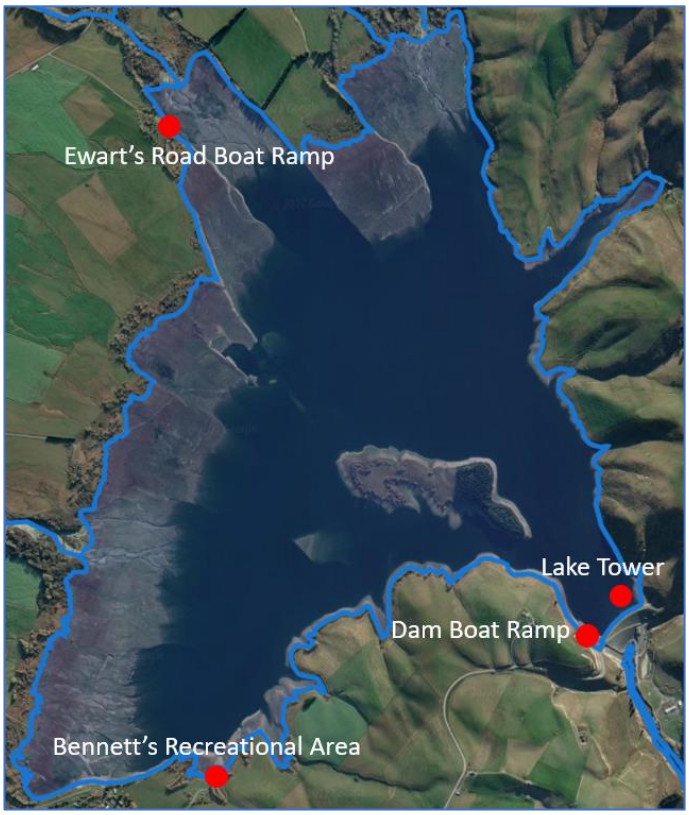
Figure 12: % reduction in water clarity in the Kakahu River between the upstream of discharge and downstream of discharge sampling locations.

The next Quarterly Water Quality Report will focus on data collected over four months between September 2022 and December 2022, to bring it in line with the financial year, and will be distributed in February 2023. Thereafter, the reporting will be undertaken on a three-month cycle.

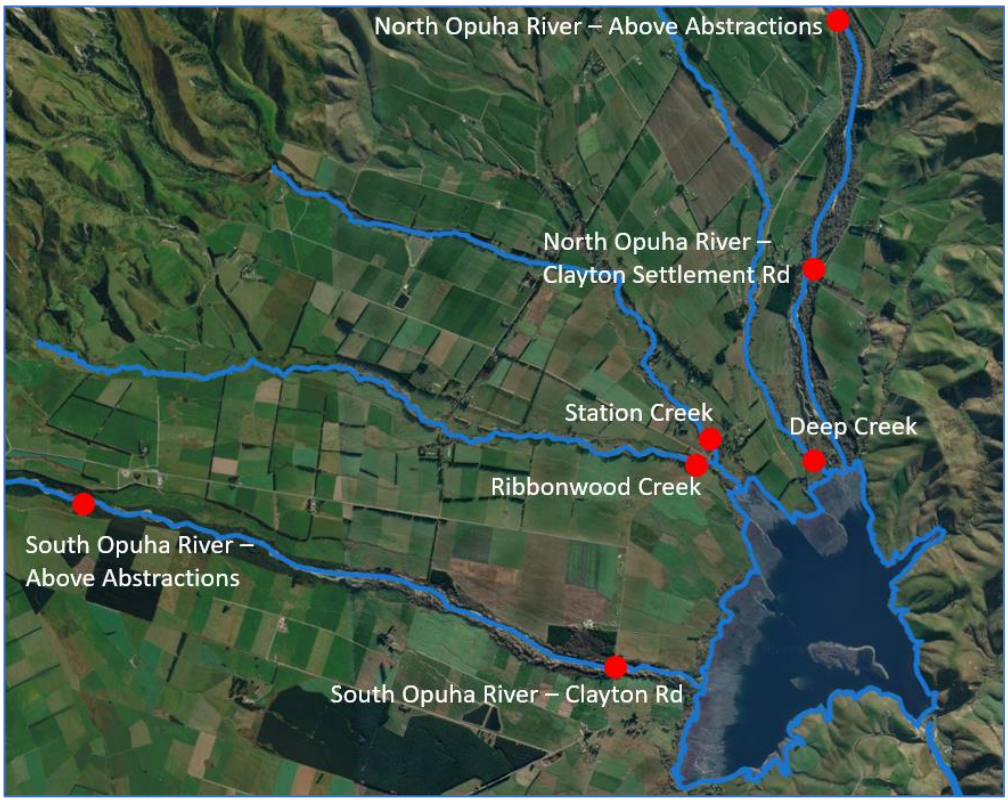
Any questions or feedback regarding the Quarterly Water Quality Report can be directed to Jared Panther (jared@opuha.co.nz; 021 223 7465) or Julia Crossman (julia@opuha.co.nz; 021 535 174).

Appendix A – Sampling Locations

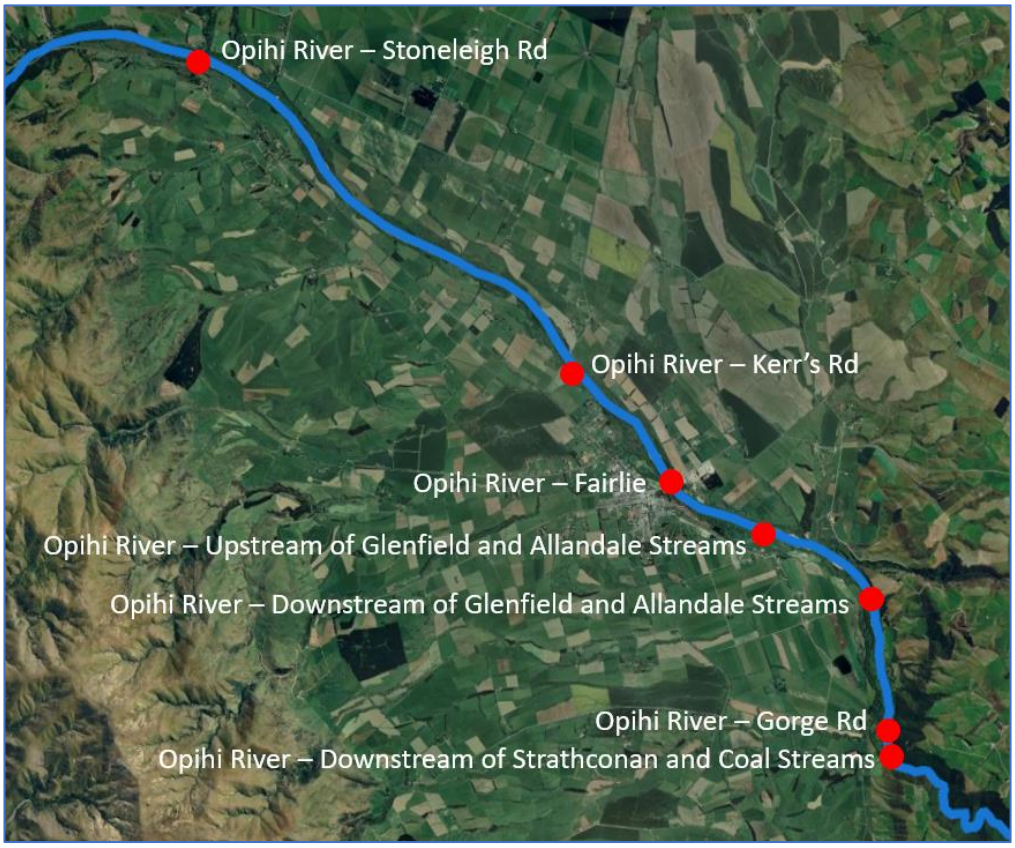
Lake Opuha Sampling Locations



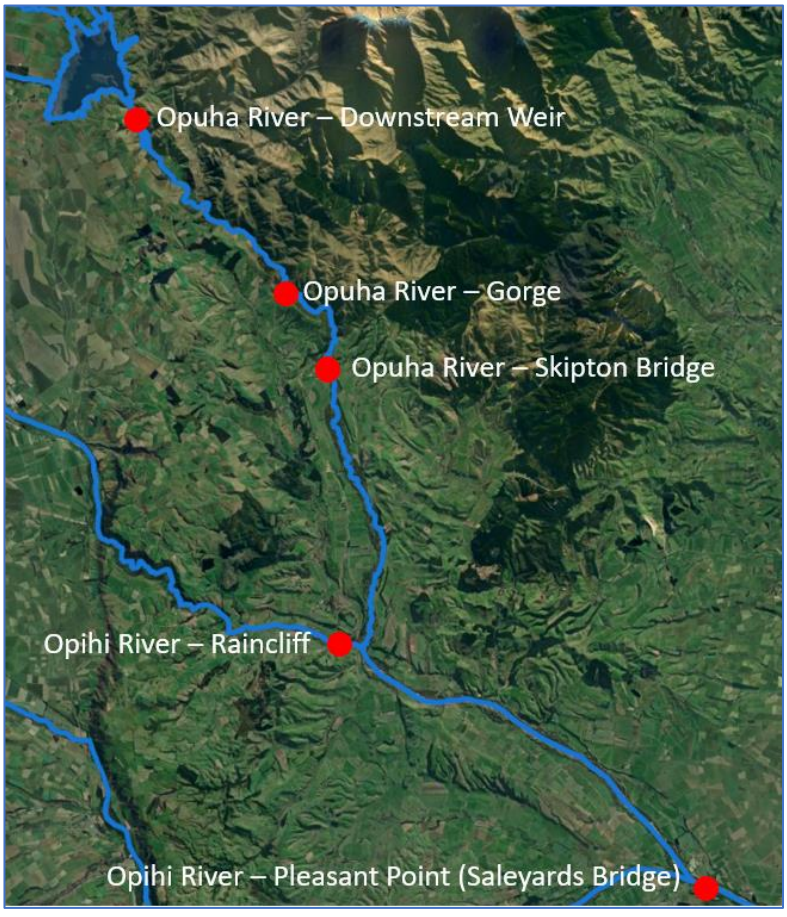
Tributaries of Lake Opuha Sampling Locations



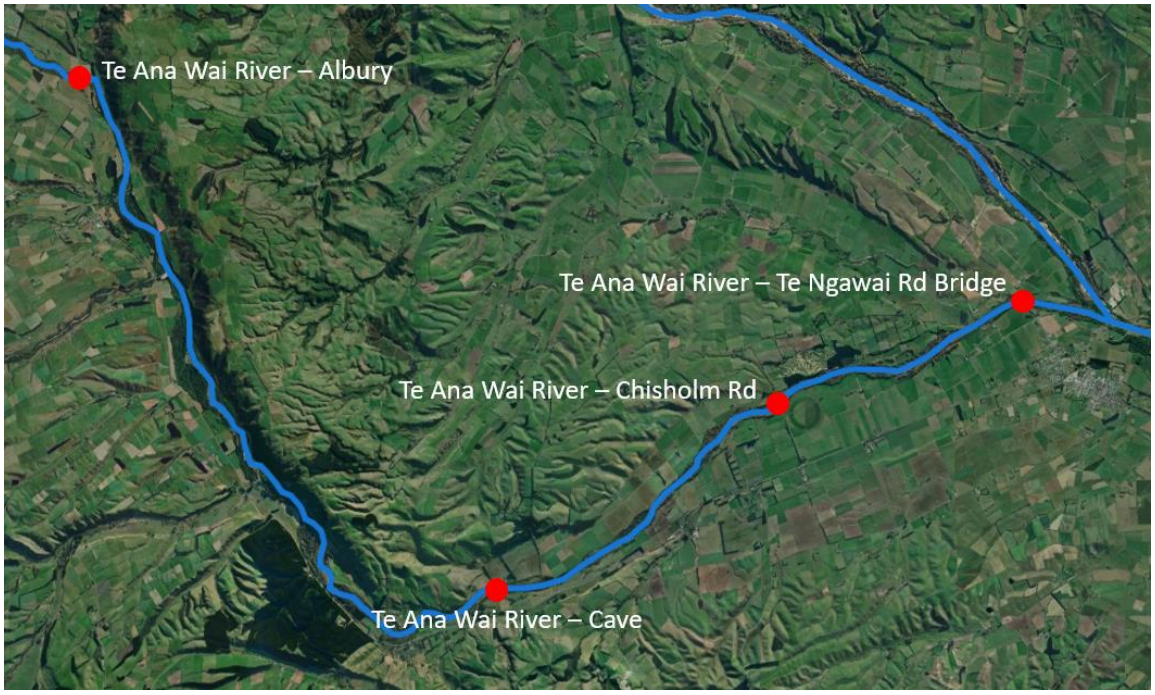
Upper Opihi River Sampling Locations



Opuha River and Lower Opihi River Sampling Locations



Te Ana Wai River Sampling Locations



Kakahu River Sampling Locations